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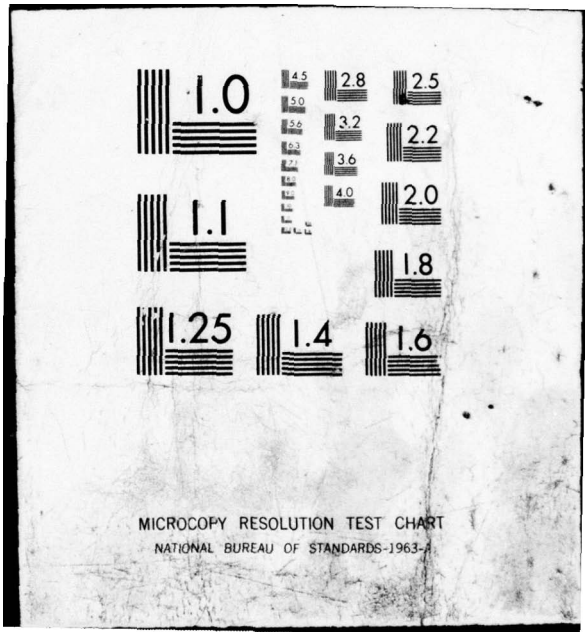
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OPERATION OF THE CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM (CAMDS) AT TOOELE ARMY DEPOT, UTAH

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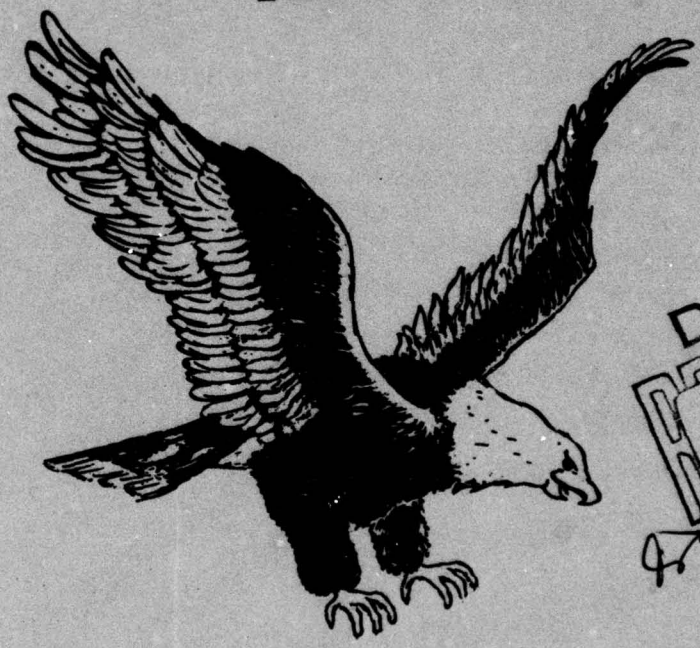

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DESIGN CRITERIA

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Chemical Agent Munition Disposal System is a prototype facility for the large scale destruction of lethal chemical agents and munitions. This document presents the primary criteria and critical design parameters for the CAMDS system and its components.

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DESIGN CRITERIA

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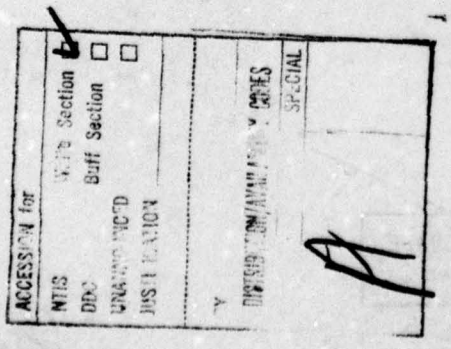

CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM (CAMDS)

DESIGN CRITERIA

I. INTRODUCTION

The Chemical Agent Munition Disposal System (CAMDS) is a prototype facility for the large-scale destruction of lethal chemical agents and chemical munitions. The system is being developed jointly by Edgewood Arsenal (EA) and Tooele Army Depot (TEAD) for installation and initial operation at the South Area of TEAD. CAMDS is intended to provide a means for the ecologically safe destruction of lethal chemical munitions under conditions of absolute and impeccable safety. CAMDS was initiated from a recognized need to develop onsite capabilities for munition disposal to preclude transport of chemical munitions and disposal by conventional means which were no longer acceptable to the public; i.e., ocean-dumping, open-pit burning, or land burial. The CAMDS being constructed at TEAD is intended to serve as a prototype for other chemical disposal facilities which may be required in the future at other munition storage locations. CAMDS, therefore, is an experimental facility in one sense and a production facility in another. The specific objectives of the TEAD CAMDS facility are as follows:

A. The CAMDS facility is a prototype general purpose chemical demilitarization plant intended to verify the adequacy of machinery, equipment, and processes for the large-scale disposal of the entire family of lethal chemical weapons.

B. The TEAD CAMDS facility is intended to provide a capability for the disposal of limited stocks of unserviceable and obsolete munitions located at TEAD.

C. The TEAD CAMDS facility is intended to be relocatable, in part, to other storage points for utilization in the destruction of limited quantities of the chemical munition stockpile.

The CAMDS program is intended to develop and utilize the most advanced techniques for handling lethal chemicals and munitions in the manner which will provide utmost safety for plant operating personnel, the surrounding populous, and the general environment.

The purpose of this document is to present the primary criteria and critical design parameters for the CAMDS system and its components. This document is not intended to describe design details, methods of plant operation, or approaches to system development.

II. GENERAL SYSTEM CRITERIA

A. Operational Requirements

1. Agent Destruction Capabilities. CAMDS will have the capability for destruction of the chemical nerve agents GB and VX and the chemical blister agents of the mustard category, including Levenstein mustard (H), distilled mustard (HD), and mustard-T mixture (HT).

2. Munition Processing Capability. The CAMDS facility will have the capability for handling all models and standard configurations of the following chemical munitions and containers.

Munition	Chemical Agent Content
M55 Rockets	GB, VX
105mm Projectiles	GB, Mustard
155mm Projectiles	GB, VX, Mustard
8" Projectiles	GB, VX
4.2" Mortar	Mustard
M23 Land Mine	VX
Bombs	GB
Spray Tanks	VX
Ton Containers	GB, VX, Mustard

3. Processing Rates. Target disposal rates for the CAMDS facility will be based on the following processing frequencies.

Munition	Items/Operating Day	Items/Hour
M55 Rockets	400/day	20
105mm Projectiles	1000/day	50
155mm Projectiles	650/day	32.5
8" Projectiles	400/day	20
4.2" Mortar	1000/day	50
M23 Land Mine	575/day	29
Bombs	24/day	1.2
Spray Tanks	5/day	.25
Ton Containers	5/day	.25

All CAMDS subsystems are expected to have compatible processing rates wherever practicable. Actual disposal rates will be experimentally determined during equipment tests and plant systemization with live munitions.

4. Condition of Munitions. CAMDS is intended for use on intact munitions. However, the plant shall also have a capability of handling leaking or damaged munitions, provided the equipment and techniques involved in the munition disassembly and agent removal are compatible

with the equipment used for large-scale demilitarization of undamaged munitions. Ideally, the system should have the capability to handle all chemical munitions at a given site when it is in operation. The cost and complexity of the CAMDS, resulting from its requirement for large output, would preclude the use of the system at a site solely for disposal of a limited number of leakers.

5. Environmental Conditions. The CAMDS system shall be designed to operate under all conditions which will be encountered at the various chemical munition storage points. The system will be expected to operate at ambient temperatures from -10°F to +110°F and from sea level to 5,000 feet above sea level. The system will be expected to operate under arid or tropical conditions.

6. Environmental Restraints. The CAMDS system shall be designed to operate under the most stringent conditions of environmental controls encountered at its location. In general, the CAMDS facility will not discharge contaminated liquids or solid residues from the site nor will it discharge atmospheric pollutants beyond the limits allowed by local, state, or Federal authorities. There shall be no discharge of process waste liquids from the CAMDS site. All brine resulting from the neutralization of agents, scrubbing of waste gas streams, and decontamination procedures shall be dried onsite. The gaseous effluent from the dryer system shall meet the emission standards described. Dried solids discharged from the dryer system shall be packaged in commercially available containers suitable for commercial transport.

Combustible solid wastes will be incinerated and all scrap materials will be thermally treated to certify them free of agent before they are removed from the site. Uncontaminated munition components may be returned to the supply system.

The allowable agent exposure concentrations for unprotected workers are:

Agent	Concentration	Duration
GB	0.001 mg/m^3	1 hour
GB	0.0003 mg/m^3	8 hours
GB	0.0001 mg/m^3	8 hours/day, indefinitely
VX	0.00005 mg/m^3	1 hour
VX	0.00002 mg/m^3	8 hours
VX	0.00001 mg/m^3	8 hours/day, indefinitely
Mustard	0.01 mg/m^3	3 hours
Mustard	0.005 mg/m^3	8 hours
Mustard	0.003 mg/m^3	8 hours/day, indefinitely

The advisory emission concentration limits for the CAMDS system have been established as follows:

Emission	Limit
Agent Mustard	.03 mg/am^3 (1-hr average)
Agent GB	3×10^{-4} mg/am^3 (2-hr average)
Agent VX	3×10^{-5} mg/am^3 (2-hr average)

The current applicable process stack emission for industrial pollutants are as follows:

Emission	Standard
SO_x as SO_2	500 ppm (by volume).
Visible Opacity	20 percent or less. This standard is interpreted to mean that no air contaminant will be emitted which is of a shade or density as to obscure an observer's vision to a degree in excess of 20 percent. An air contaminant is defined as any fume, smoke, particulate matter, vapor, gas, or any combination thereof, but not including water vapor or steam condensate.
Process Particulates	$E = 3.59\ P^{.62}$ where, E = allowable emission rate, lb/hr, P = weight of material (combustible and noncombustible, excluding gas and liquid fuel) introduced, tons/hr.
Incinerator Particulates	0.2 gr/scf corrected to 12% CO_2 (Tooele). 0.1 gr/scf corrected to 12% CO_2 (all sites).

The current applicable Federal primary and secondary air quality standards are as follows:

Sulfur Dioxide:

Primary: a. 80 $\mu g/m^3$ - annual arithmetic (0.03 ppm) mean

b. 365 $\mu g/m^3$ - 24-hr maximum (0.14 ppm)

Secondary: 1300 $\mu g/m^3$ - 3-hr maximum (0.5 ppm)

Particulate Matter:

Primary: a. 75 $\mu g/m^3$ - annual geometric mean

b. 260 $\mu g/m^3$ - 24-hr maximum

Secondary: a. 60 $\mu g/m^3$ - annual geometric mean

b. 150 $\mu g/m^3$ - 24-hr maximum

Photochemical Oxidants:

Primary 160 $\mu g/m^3$ - 1-hr maximum

Nitrogen

Primary and Secondary 100 $\mu g/m^3$ - annual arithmetic (0.05 ppm) mean

Agents

a. HD - 0.0001 mg/m^3 - 72-hr average

b. VX - 3×10^{-7} mg/m^3 - 72-hr average (based on allowable 24-hr exposure dosage of 0.0005 $mg\text{-}min/m^3$)

c. GB - 3×10^{-6} mg/m^3 - 72-hr average (based on allowable 24-hr exposure dosage of 0.005 $mg\text{-}min/m^3$)

B. System Design Criteria

1. Moveability. The CAMDS system shall be constructed in modules which can be disassembled, decontaminated, and moved on railroad flat cars. CAMDS structures shall be of the knock-down type with bolted construction. When disassembled and in the transportable mode, the subassemblies shall not exceed any of the following parameters:

Length: 40 feet
Width: 10 feet
Height: 11 feet
Gross Weight: 40 tons

The CAMDS subassemblies shall be designed to facilitate transfer and shall also be designed to be easily decontaminated prior to disassembly and shipment. The relocatability characteristics shall apply only to CAMDS equipment and structures. It shall not apply to foundations and those components of the system which can be more economically replaced than moved.

2. Maintainability. The CAMDS equipment shall be designed to facilitate maintenance and to provide the highest feasible equipment reliability. Special attention must be provided to those systems which will be required to function in a toxic environment. Maintenance should be absolutely minimized and simplified.

Equipment adjustments will be easily accessible to persons in level A protective clothing. The number of adjustment points will be minimized by the use of dowel pins where practical. Tools required shall be easily operable by a man in level A protection. Specific points to be considered in machine design are:

a. The use of multiposition, slotted or adjustable parts and assemblies should be minimized or, if possible, eliminated.

b. High wear parts, components or assemblies should be designed to allow easy removal and replacement.

c. Microswitches should be of the plug-in type.

d. Where possible, quick disconnect fittings should be used.

e. Lubrication fittings should be easily accessible and minimized.

f. Design, selection and location of sensors will be such that a minimum of cleaning, adjustment or calibration is required.

g. Coolant systems must be designed with accessibility in view. Filters should be located where their cleaning or replacement can be accomplished without leakage.

Equipment will be designed in a manner that will simplify decontamination procedures. Men in level A protective gear must be able to break down machinery into subassemblies which can be decontaminated effectively. Sharp edges, corners or protrusions which could tear or cut protective clothing should be kept to a minimum.

Care must be taken to select materials of construction best able to withstand the corrosive effects of decontamination solutions and agents. Aluminum should never be used where agent contamination might occur since caustic decontamination solutions will destroy aluminum, generating a potential hydrogen gas hazard.

Use of hydraulic lines and air pressure lines inside toxic areas will be minimized.

Illumination levels will be a minimum of 100-foot candles for assembly work on demil machines.

Space will be provided around equipment for easy access. Forty inches on all sides is considered desirable where level A protection is required.

3. Contamination Containment.

a. General. All CAMDS processes shall be designed to contain all toxic materials within piping systems, tanks or drain fixtures to the maximum extent possible. All munition disassembly and draining operations, handling and detoxification of contaminated material, and detoxification of agent shall be conducted in ventilated toxic areas. All toxic areas shall have walls and floor curbs of such materials and construction to facilitate decontamination and washdown. Toxic areas shall have floor drains and sumps with provisions for transferring sump contents to a waste neutralization facility.

b. Ventilation.

(1) In all CAMDS toxic areas where there is a potential for agent spills or contamination, the area will be enclosed and ventilated at a minimum rate of 25 air changes per hour. The exhaust air will be filtered through high efficiency particulate air filters and charcoal. Ventilation ducting shall be designed to minimize the dispersion of contamination. A minimum face velocity of 150 feet per minute shall be maintained at all openings into the toxic enclosure. A minimum of 0.15 inches water column negative pressure shall be maintained in the toxic enclosure when all openings are closed.

(2) In process areas where there is only potential for very low levels of agent contamination, the area shall be ventilated at a rate of six changes per hour and the exhaust will be charcoal filtered.

c. Airlocks. Entry and exit from 25 air change/hour toxic enclosures shall be via airlock. Facilities shall be provided in the airlocks for decontamination of protective clothing, and for checking the adequacy of the decontamination. Personnel inside the airlock shall be visible from the clean area.

4. Area Surveillance. The CAMDS site will be continually monitored to detect hazardous levels of chemical agents as early as possible. Detectors will be located in areas which will not expect to be contaminated during normal operations but which may be entered by unprotected personnel. Suitable agent detectors will also be provided in all air exhaust systems and stack exhausts to provide immediate indication and alarm of accidental release of chemical agents.

5. General Design. Structural and electrical designs shall conform to federal, state and local codes. All electrical fixtures shall conform to NEMA standards.

Facilities shall be provided with emergency utility sources as required to allow safe shutdown upon failure of normal supplies. All housings will be designed for a minimum live load force of 30 psf and a 20 psf wind load in addition to the structural dead load.

6. Standardization of Parts and Materiel. To every extent possible, the various CAMDS subsystems will utilize interchangeable parts, components, and materiel.

C. Safety

CAMDS system and equipment designs shall adhere to the following regulations, standards, and guidelines:

1. OSHA Standards - Federal Register, 18 October 1972.

2. DOD Standard - DOD 5154.4S.

3. DA Regulations.

a. MIL-STD-992, System Safety Program for Systems and Associated Subsystems and Equipment.

b. MIL-STD-1472A, Human Engineering Design Criteria for Military Systems, Equipment, and Facilities.

c. AR 385-10, Army Safety Program.

d. AR 385-161, Safety Program for Chemical Agents and Associated Weapons Systems.

e. AR 50-21, Chemical and Biological Accident/Incident Control.

f. AR 385-32, Protective Clothing and Equipment.

g. AR 190-2, Physical Security Standards for Storage of Chemical and Biological Agents and Munitions.

h. AR 385-60, Coordination with Armed Services Explosives Safety Board.

4. AMC Regulations.

a. AMCR 385-100, Safety Manual.

b. AMC Supplements to AR 385-10 and AR 385-161.

c. AMCR 385-31, Safety Regulations for Chemical Agents H, HD, and HT.

d. AMCR 385-102, Safety Regulations for Chemical Agents GB and VX.

e. AMCR 385-27, Safety Regulations for Disposal of Bulk Chemical Agents and Munitions.

f. AMCR 385-1, Safety Responsibilities and Program Requirements.

g. AMC 11-5.

5. References/Guidelines.

a. Report of the Senior Advisory Panel on the Demilitarization of Chemical Munitions/Agents (Gross Committee Report), 27 July 1972.

b. FM3-21, Chemical-Biological Accident Contamination Control.

c. TM 10-277, Protective Clothing Chemical Operation.

d. TM 3-250, Storage, Shipment, Handling and Disposal of Chemical Agents and Hazardous Chemicals.

e. AMCR 385-23, Management System Safety.

f. Report of the Senior Advisory Panel on the Demilitarization of Chemical Munitions/Agents, 27 July 1972.

III. BUILDING BLOCK CRITERIA

A. Unpack Area. A totally enclosed area will be provided to receive and unpack all munitions except bombs and bulk items. Sufficient floor space will be available to process munitions at the design rates. (In order to meet quantity distance requirements, the explosive content of munitions in the Unpack Area shall not exceed 50 pounds.) During normal operations, the Unpack Area will only handle sealed munitions, but provisions must be made to handle the possibility of contamination from an undetected leaking burstered munition. The Unpack Area will be ventilated at a minimum rate of six air changes per hour through an activated charcoal filter system.

The Unpack Area will provide access to the contaminated Explosive Containment Cubicle for men, munitions and equipment. Access will be through an airlock ventilated at 25 air changes per hour. Openings in the airlock will be designed to preclude backflow of contamination from the Explosive Containment Cubicle and the airlock to the uncontaminated Unpack Area.

The building will be of bolted construction to ease disassembly and reassembly. Welds that will prevent easy disassembly are prohibited. The floor will be non-sparking surface. Electrical fixtures for operating equipment will meet electrical code requirements for an explosive environment. The area will be accessible to a forklift truck carrying a pallet of M55 rockets.

B. Explosive Containment Cubicle. The Explosive Containment Cubicle (ECC) will confine the gases and fragments generated by the explosion of a single 8 inch projectiles. The ECC will be designed to house automated, remote controlled machinery for demilitarization of burstered projectiles, rockets, mortars and mines. The maximum number of rounds in the ECC while hazardous disassembly operations are in progress will be as follows:

Item	Explosive Content	# Rounds
155mm Projectiles, Mustard	.41 lbs tetrytol	2
155mm Projectiles, M121A1	2.45 Comp B	1
155mm Projectiles, M122	2.72 tetrytol	1
8" Projectiles	7.5 lbs Comp B	1
105mm Projectiles, M360	1.1 tetrytol, Comp B	2
M55 Rockets	3.2 Comp B	1
M23 Land Mines	1.38 Comp B	1
4.2" Mortars	.14 tetrytol	2

The ECC will be completely closed and sealed during operations on explosive components. Entrance and exit doors will be automatically operated. A single personnel door will be provided for entrance and exit of maintenance personnel. Door seals will be designed to withstand repeated cycling. The ECC will be ventilated through charcoal filters to remove air overpressure before munition or personnel doors are opened.

Penetrations through the ECC walls will be provided for electrical, hydraulic and pneumatic services required by the demil machinery and for decon and agent piping. A life support system will be provided within the ECC to provide air to maintenance personnel working in air-fed protective clothing. The ECC will be sufficiently lighted to permit observation of demil machinery by a closed circuit TV system and to provide adequate visibility for maintenance personnel.

Dimensions of the ECC will be limited by the criteria for moveability cited in Section II.B.1. Placement of equipment inside the ECC must consider the space requirements for personnel working in Level A protective clothing as described in Section II.B.2.

The ECC will be located within a heated and ventilated housing. The ECC housing will be used for equipment requiring close proximity to the ECC but not needed inside the ECC proper. The building will be of bolted construction to ease disassembly and reassembly. The ECC housing will be considered a toxic area and will be ventilated at a nominal rate of 25 air changes per hour through activated charcoal. Entrance to and exit from the housing will be through an airlock containing a personnel decon shower.

C. Deactivation Furnace System. The Deactivation Furnace System (DFS) will thermally destroy propellant and explosive munition components. It will also detoxify agent contaminated materials processed along with these explosives and propellant. The DFS shall be designed for automatic and continuous processing of munitions or munition components from the ECC. Processing rates for the munitions are given in Section II.A.3.

Although the Deactivation Furnace will be designed to burn explosives and propellant without detonation, the furnace retort shall be constructed of material sufficient to confine munition fragments should a detonation occur. Secondary protection from fragments will be provided by an external concrete barricade. The munition entrance to the furnace shall be designed to preclude backflashing down the input conveyor.

In processing the rockets, land mines, and bursters in the furnace retort, traces of chemical agents may be present in the Deactivation Furnace gaseous effluent. To thermally decompose any such traces, the gases shall pass through an afterburner which will maintain the gas at a minimum temperature of 1600°F for a minimum residence time of 0.5 seconds. The afterburner chamber will be brick-lined to eliminate cold spots.

The air pollution control system shall be capable of handling continuously the gaseous effluent from the afterburner. Emissions from the system shall meet the plant emission criteria in Section II.A.6.

The DFS shall be equipped with automatic and manual backup emergency shutdown devices to safely shut all systems down in the event of a process upset condition that could physically damage the system or present a safety hazard.

The furnace system will have the following features:

1. The burners will be oil fired.

2. The retort will be designed to assure that parts discharged will be at 1000°F.

3. A draft 0.1 inches water gauge relative to ambient conditions shall be maintained in the system during normal processing.

The furnace barricade enclosure will be ventilated at a nominal six air changes per hour.

D. Metal Parts Furnace. The purpose of the Metal Parts Furnace System (MPF) is to thermally destroy residual agent contamination on shell bodies and containers in which the toxic agents are stored. It is also required to thermally destroy mustard agent in munitions and containers.

The MPF shall be designed for automatic and continuous processing of unburstered projectiles, bulk items and ton containers listed in Section II.A.2. GB and VX munitions and ton containers will have been drained prior to entering the furnace. The quantity of GB or VX product to be processed per item shall be limited to 5 percent (by weight) of the total agent in each item. Mustard munitions and ton containers will enter the furnace filled. The mustard agent will be volatilized in the furnace and thermally destroyed in the afterburners. The furnace system shall also have the capability of punching holes in ton containers to permit volatilization of agent.

The furnace shall be brick-lined to eliminate cold spots. The amount of excess air flowing through the furnace shall be kept to a minimum consistent with design requirements. A negative pressure relative to ambient conditions shall be maintained throughout the furnace at all times, including the intermittent periods of peak burn that will occur during the burning of mustard munitions.

The furnace module design shall include an automated material handling system capable of accepting, feeding, and carrying the metal part loads through the furnace and delivering the detoxified scrap to material handling equipment. The automated material handling system shall be resistant to chemical attack.

The afterburner module shall be brick-lined. Ignition shall be maintained at all times when a charge is fed to the furnace.

The air pollution control equipment shall be designed for automatic and continuous removal of the gaseous and particulate products formed in and by the furnace module and the afterburner. The degree of gaseous and particulate removal shall be such that emission standards for stack gases shown under general design criteria shall be met. All liquids, including those which result from quenching, scrubbing or wet particulate removal, will be transferred to the Agent Destruction System for further processing. Scrubbing brine will only be transferred after the hold tanks are determined to contain excess caustic.

The Metal Parts Furnace System shall be instrumented to insure fail-safe automated operation and prevent damage from occurring to the equipment. The furnace will have an emergency deluge system for quickly cooling bulk items in case of total afterburner failure. The start-up, shutdown, and emergency shutdown operations of the furnace modules, afterburner and air pollution control module shall be interlocked. First consideration shall be given to the utilization of control valves, actuators, positioners, and auxiliaries associated with the control systems which are of the electronic type rather than pneumatic.

The furnace charge area is a contaminated zone and will be ventilated at a nominal rate of 25 air changes per hour. The space around the furnace will be a 6 air change per hour zone. Exhaust from these zones will be filtered through activated charcoal.

E. Rocket Demil Machine. The Rocket Demil Machine (RDM) will drain GB and VX agent from M55 rockets and reduce the rocket to pieces small enough to be processed by the Deactivation Furnace. The machine will be automated and remotely controlled by a digital computer. The machine will be housed and maintained within the ECC.

The Rocket Demil Machine will remove a minimum of 95 percent of the agent from the rocket warhead. Agent will be drained in a manner to minimize equipment contamination and will be transferred to the Agent Destruction System. An agent measuring system will be provided to insure removal of at least 95 percent of the agent from normal warheads. Agent removal will be accomplished prior to reduction of explosives and propellants.

The machine operation will be controlled from the CAMDS Control Center. An alternate manual control system will be provided as a back-up to the computer. The machine controls will be interlocked with the ECC, conveyors and the Deactivation Furnace to assure fail-safe operations.

To reduce the possibility of initiating explosive components, the rockets will be cut in a coolant bath, preferably containing a decontamination solution. Saw blades will be operated at slow speeds. Rocket pieces will be fed to the Deactivation Furnace input conveyor in a sequence designed to preclude overloading of the furnace.

The Rocket Demil Machine, with its input and discharge conveyors, will be designed to process a minimum of 400 M55 rockets per 20 hour operating day under continuous operation.

F. Dunnage Incinerator. The Dunnage Incinerator will destroy uncontaminated dunnage composed of wooden pallets and combustible packing material (excelsior and styrofoam) generated in the Unpack Area. The incinerator will be capable of destroying 500 pounds per hour of uncontaminated dunnage. Saws will reduce the dunnage into pieces small enough for feeding into the incinerator.

The incinerator, when operated at the design capacity, will meet the particulate emission standard cited in Section II.A.6. The Dunnage Incinerator will be located in prefabricated housing to provide weather protection for the equipment.

G. Utilities. The Utilities building block will provide steam, water, compressed air, hydraulic fluid and sanitary waste disposal services for the CAMDS site.

Steam will be provided for the Metal Parts Furnace, Agent Destruction System, and also for heating equipment housings. Steam will be supplied by oil fired boilers. Boilers shall be designed for a pressure of at least 225 psig. Steam pressure will not exceed 150 psig during normal operations. Moisture in the steam shall not exceed 1 percent at maximum continuous rated boiler capacity. Boilers will be equipped with alarm systems for low water, high stack temperatures and high steam pressure.

Steam heat will be supplied to the housings for the Agent Destruction System , Metal Parts Furnace, Deactivation Furnace, Unpack Area, Explosive Containment Cubicle, Projectile Disassembly Facility, Bulk Item Facility, and Explosive Treatment System, and must be capable of maintaining these equipment systems at 70°F.

The water system will provide water at sufficient quantity and quality for all plant uses, including process operations, steam generators, decontamination, firefighting and personnel services. The system will provide treated water to the Deactivation Furnace, Metal Parts Furnace, and Agent Destruction System.

A septic system will be of sufficient size to handle sewage and waste water generated in the Personnel Support Complex by as many as 150 people per day.

Compressed air for industrial use will be available at 100 psig at designated site locations. Compressors must be designed to operate at 5500 feet above sea level with inlet air temperatures between 20°F and 110°F. Compressed air leaving the receiver tanks shall have a maximum dewpoint of -20°F.

The facility will have life support air in all toxic areas. The compressors and distribution system for the life support air shall be independent of the industrial air system. The air will meet the requirements of the US Army Environmental Hygiene Agency Technical Guide, "Compressed Breathing Air", April 1975.

Two separate hydraulic units will be provided for the CAMDS site: one unit will serve the ECC and related equipment; the other unit will service the Projectile Pull and Drain System and the Bulk Item Facility. The units will each be capable of delivering 20 gpm of fluid at 900 psi. The units will be located in housings ventilated at six air changes per hour.

The use of hydraulic activated devices will be minimized in toxic areas. Pumps, valves and piping connected to lines entering a toxic area will be located in a six air change area.

H. Explosive Containment Cubicle Hydraulic Module. This module will provide a shelter for motors, air and hydraulic units used in the Explosive Containment Cubicle, including feed and discharge conveyors.

The module will consist of a small, portable trailer. It will be a six change per hour location because of potential low level contamination to the area from the hydraulic fluid used in the Explosive Containment Cubicle.

I. Control Center. This module will house the computer and control panels for the computer controlled operations and control panels for the Deactivation Furnace, Metal Parts Furnace, Explosive Treatment System, and Central Decon System. It will also contain closed circuit television monitors for watching critical operations. Within space and design limitations, controls for all other equipment will be located in the Control Center. Critical process parameters will be monitored and recorded at the center. This module will also provide work space for six CAMDS supervisory personnel.

The module will consist of one or more portable trailers attached to a structural steel skid frame and so designed that it will not require concrete or special foundations.

J. Personnel Support Complex. The following functions and facilities will be housed in the Personnel Support Complex:

1. Issue and storage of protective clothing and coveralls and vented storage for used protective clothing.

2. Personnel lockers and change areas.

3. Toilet facilities.

4. Lunch room.

5. Shower facilities.

The Personnel Support Complex will consist of interconnected portable housings including shower and change modules, locker modules, a clothing storage and toilet module, a toilet and lunch room module, and a protective clothing storage and change module. The protective clothing storage and change module will be exhausted through a charcoal filtered ventilation system. A hot liquid waste collection system will be provided to collect potentially contaminated shower wastes. The complex will be sized to handle 150 people per day, 55 people per 8-hour shift.

K. Agent Destruction System. The Agent Destruction System shall detoxify bulk agent GB and VX. It is required to process a minimum of 8700 pounds of agent GB and 8700 pounds of agent VX per day, with only one agent being processed at any one time. It shall also detoxify plant liquid waste streams containing trace amounts of GB, VX or mustard. The system shall also provide aqueous brine drying equipment for detoxified agent solution as well as for all other CAMDS process solutions and wash-down liquors.

The agent GB will be detoxified using aqueous sodium hydroxide. Agent VX is to be detoxified by chlorination in an aqueous acid medium, followed by caustic neutralization. Wastes coming from other CAMDS building blocks will be tested at the Agent Destruction System for residual agent concentration and, if warranted, additional treatment of these wastes (with sodium hydroxide) will be made to assure complete detoxification. The Agent Destruction System shall contain a toxic module where all agent processing will be performed. The Agent Destruction System housing shall also contain the brine drying system. The bulk storage tank farm and a water cooling tower will be located outside the Agent Destruction System housing but in close proximity to it. A railroad spur will be provided in close proximity to the bulk storage tank farm to receive bulk chemicals (chlorine, hydrochloric acid and sodium hydroxide).

The agent process module design shall include all necessary process equipment (including process vent scrubber, pumps, heat exchangers, reactors, agitators, etc.) determined as necessary from pilot studies and have provisions for storage capacity of 8 hours (minimum) for holding detoxified liquids isolated from the process. The storage tanks shall have provisions for adding additional chemicals to assure complete detoxification. Additional mixing tanks will be provided for the miscellaneous CAMDS wastes and miscellaneous Agent Destruction Systems wastes (from sumps, vent scrubber, etc.) to provide for the necessary treatment and holding time to assure complete detoxification of these streams before bulk reduction.

The design shall also include separate agent storage tanks for GB and VX with a minimum capacity of 24 hours of operation for each agent. The

design shall include a sump tank below the tanks capable of holding a minimum of 110 percent of the agent storage tank capacity and a means of emptying the sump tank.

The brine drying system shall be designed for automatic and continuous processing of the detoxified liquor produced in the neutralization area. This area shall contain all equipment necessary to reduce the detoxified liquor to a dry product or sludge, based on economic considerations, which will not produce either hazard or nuisance from dust, solid fumes or corrosion. The product exiting the bulk reduction area shall be compacted and/or packaged in commercially available containers.

Air pollution control equipment shall be designed for automatic and continuous removal of the gases and particulate pollutants including, but not limited to, chlorine, hydrogen chloride and chemical agents GB and VX vented from the process equipment. Gaseous effluents from the air pollution control equipment shall be vented to the effluent stack through an activated charcoal filter system.

The gaseous effluent from the bulk reduction module shall meet the gaseous and particulate emission standards cited in Section II.A.6.

The Agent Destruction System shall be instrumented to insure fail-safe automated operation and prevent damage from occurring to the equipment. First consideration shall be given to the utilization of control valves, actuators, positioners and auxiliaries associated with the control systems which are of the electronic type rather than pneumatic and are compatible with computer monitoring and control.

The control design shall include adequate sensors, controls and safeguards to shut the Agent Destruction System down without damage upon the loss of commercial electrical power.

The Agent Destruction System shall be equipped with automatic and manual backup emergency shutdown devices to safely shut the systems down in the event of a process upset condition that could physically damage the system or present a safety hazard.

The agent processing module will be considered a contaminated area and will be ventilated at a nominal rate of 25 air changes per hour through an activated charcoal filter system. Entrance and exit to the area will be through airlocks containing a shower and a means of personnel decontamination. A life support air system will be provided in this area. The brine processing area will be an uncontaminated zone and will be ventilated at a rate sufficient to remove heat and dust.

L. Explosive Treatment System. The Explosive Treatment System (ETS) will remove sludge and dissolved explosives from spent decontamination solutions used in the Explosive Containment Cubicle. It will also transfer fresh decon solutions to the ECC and the ECC housing.

During GB operations in the Explosive Containment Cubicle, the decon solution will be a sodium carbonate solution. A calcium hypochlorite solution will be used during VX and mustard operations. The facility will have the capacity to provide 150 gallons per hour of decon solution.

The Explosive Treatment System will contain equipment for filtration of undissolved suspended solids including propellant and explosives and for absorption of dissolved propellant and explosives on activated charcoal. A mixing tank for sodium carbonate solution will also be provided. Provisions must also be made for periodic removal of filtered materials and spent charcoal for disposal in the Deactivation Furnace. The facility will be located in a separate housing capable of disassembly and relocation. The control panel and the annunciator/alarms will be located in the control module. Pumps and control valves shall function automatically with electrical interlocks where necessary to assure safety of operations. Provisions shall be made for manual override of automatic functions.

M. Projectile Demil Machine. The Projectile Demil Machine will remove explosive components from projectiles containing bursters, supplementary charges and fuzes. It will also reduce bursters to a size that will allow their destruction in the Deactivation Furnace. The Projectile Demil Machine will be designed to meet the process rates specified in Section II.A.3. The machine will operate and must be maintained inside the Explosive Containment Cubicle. The design of the machine must, therefore, consider the special requirements of maintenance in cramped quarters by personnel in level A protective clothing (Section II.B.2.).

The machine will be capable of removing nose closure plugs, fuzes, bursters and supplementary charges remotely and automatically inside the Explosive Containment Cubicle. The machine will be computer controlled but it will also have an alternate remotely operated control system.

The machine will be capable of performing the following functions:

1. Remove the fuze or nose closure plug from the projectile.

2. Remove burster from the projectile after fuze/nose closure removal has been accomplished.

3. Cut the burster into two or more sections.

4. Remove the supplementary charge and steel cup from 155mm and 8 inch projectiles prior to burster removal.

To prevent heating of the explosive components, any sawing operations will be conducted using a water based lubricant, large diameter blades and low blade velocity. The coolant system will be of a recirculatory type. The metal chips and cuttings collected will be of sufficient size to allow uninterrupted operation of the Projectile Demil Machine for a minimum of 4 hours.

Sensors and interlocks will be included in the design to monitor and control operations and to assure fail-safe shutdown of the equipment if malfunctions occur. The monitoring and control requirements are listed below:

1. Determine whether projectile is correctly positioned.

2. Provide indication that the projectile holding fixtures are properly closed.

3. Provide a method of determining saw blade condition.

4. Provide positive indication that sawing is completed.

5. Monitor coolant pressure and rate during sawing operations.

A material handling system will be provided to transfer projectile components from the machine to conveyors which will move processed projectiles to the Projectile Pull and Drain Machine, and fuzes, nose closures, supplementary charges, and sectioned bursters to the Deactivation Furnace.

N. Projectile Pull and Drain Machine. The Projectile Pull and Drain Machine will remove burster wells from all projectiles and nose closures from unburstered projectiles. In addition, it will drain the agent from all VX and GB-filled projectiles. These agents will be transferred to the Agent Destruction System for chemical detoxification. Mustard agent will remain within the mustard projectiles which will be conveyed to the Metal Parts Furnace for thermal destruction of the agent fill.

The Projectile Pull and Drain Machine will be designed to meet the process rates specified in Section II.A.3.

The Projectile Pull and Drain Machine shall be located within the Projectile Disassembly Facility and shall be enclosed by a shroud. Munitions shall enter and exit the shroud by an enclosed conveyor. The shroud and the conveyor enclosures will be contaminated areas and will be ventilated at a nominal rate of 25 air changes per hour through activated charcoal filters.

The machine will check for the presence of bursters. The machine will automatically stop processing if a burstered projectile is detected and these munitions will be removed immediately.

The machine will have the capability of removing burster wells assembled to projectiles by press fitting or by welding. Provisions will be made to rinse removed burster wells in a decon bath prior to conveying these items to the Metal Parts Furnace.

At least 95 percent of the agent within VX and GB munitions shall be removed and transferred to the Agent Destruction System. Residual VX and

GB, which is not to exceed 5 percent of the original fill, shall be thermally destroyed in the Metal Parts Furnace. Agent will be aspirated through a tube lowered in the projectile cavity. The agent removal pump must be capable of removing at least 95 percent of the agent in the following times:

105mm Projectiles - 53 seconds
155mm Projectiles - 101 seconds
8 inch Projectiles - 109 seconds

The machine will be capable of performing its functions remotely and automatically. The machine will be computer controlled from the Control Center but it will also have a remotely operated alternate control system. Sensors and interlocks will be included in the design to monitor and control operations and to assure fail-safe shutdown of the equipment if malfunctions occur. Some of the monitoring and control requirements are listed below:

1. Determine if projectile is properly positioned.

2. Verify the absence of bursters.

3. Verify pulling of burster well.

4. Verify draining of the agent from GB and VX projectile cavities.

The input conveyor should be capable of accumulating projectiles equivalent to 30 minutes of production. The input conveyor will automatically shutdown when the accumulator is full. The Projectile Pull and Drain Machine will be designed to facilitate maintenance in a toxic environment by personnel in level A protective clothing.

O. Mine Demil Machine. The Mine Demil Machine will remove agent VX from M23 land mines and separate the explosive components sufficiently to allow safe destruction of the energetic materials and decontamination of the mine body in the Deactivation Furnace. The machine will operate within the Explosive Containment Cubicle. The processing rates for the Mine Demil Machine, including its feed and discharge conveyor systems, are cited in Section II.A.3.

The mine machine will be designed for continuous automated operation under computer control from the Control Center. Design of the machine components should consider the special requirements for maintenance in the relatively confined, contaminated environment of the ECC by personnel in level A protective clothing. The design should prevent or minimize the spread of contamination by the mine body as it is processed through the ECC and to the Deactivation Furnace.

Agent draining operations will be accomplished after the ECC is sealed but before explosives are removed. Provisions will be made to measure the

amount of agent removed from each mine and to assure at least 95 percent of the agent is drained. Agent will be pumped to the Agent Destruction System for disposal.

Sensors and automatic interlocks will be included in the design to monitor and control operations and to assure fail-safe shutdown of the equipment if malfunctions occur.

P. Mortar Demil Machine. The Mortar Demil Machine will remove the M8 fuze and M14 burster from the 4.2 inch M2/M2A1 mortar cartridge at the rates indicated in Section II.A.3.

The Mortar Demil Machine will be located inside the Explosive Containment Cubicle and will be automatically operated by computer from the Control Center. It will also be operable by an alternate remotely operated control system. The design of the machine will consider the special requirements of maintenance in the close confines of the ECC by personnel in level A protective clothing (note maintenance criteria in Section II.B.2.).

Mortar cartridges less cartridge cases will enter the Explosive Containment Cubicle by conveyor through the material airlock in the Unpack Area. The mortar machine will remove the fuze and burster then transfer both items by conveyor to the Deactivation Furnace for destruction. The mortar round will be conveyed to the Projectile Pull and Drain Machine for further processing.

Due to the small amount of explosive contained in the mortar rounds, more than one cartridge may be processed at a time, provided cartridges with fuzes or fuze and bursters are separated by at least 12 inches. Rotational speed of the defuzing equipment shall not exceed 75 rpm.

Sensors and automatic interlocks will be included in the design to monitor and control operations and to assure fail-safe shutdown of the equipment if malfunctions occur.

Q. Central Decon System. The Central Decon System stores and supplies decontamination solutions for GB operations and stores, supplies, and mixes decon solutions for VX and mustard operations. The Central Decon System will be housed in the Projectile Disassembly Facility with the control and annunciator/alarm system located in the Control Center. Pumps and control valves shall function automatically with electrical interlocks where necessary to assure safety of operations. Provisions should be made for manual override of automatic controls.

The Central Decon System shall supply sodium hydroxide solution to the Bulk Item Facility, the Projectile Pull and Drain Machine and the Metal Parts Furnace projectile loading area when processing GB munitions and bulk containers. The decon solution will be received from the Agent Destruction System, stored in a 1200-gallon tank and pumped on demand to user stations. The Central Decon System shall have a minimum capacity to provide 850 gallons of decon solution per day based on the decon requirements for processing five GB ton containers per day in the Bulk Item Facility.

The Central Decon System shall also supply calcium hypochlorite solution to the Bulk Item Facility, Projectile Pull and Drain Machine, Explosive Treatment System and Metal Parts Furnace when processing VX and mustard munitions and bulk containers. The Central Decon System shall prepare the decon solution from calcium hypochlorite powder, store the solution in two 600-gallon tanks, and pump the solution on demand to user stations. The Central Decon System shall have the capacity to provide 850 gallons of solution per day based on processing five VX ton containers or spray tanks in the Bulk Item Facility.

The Central Decon System shall only handle fresh decon solutions. A floor drain and sump shall be provided to contain liquid leakage or spills from the Central Decon System. Sump contents shall be pumped to the Agent Destruction System for drying.

R. Projectile Disassembly Facility. The Projectile Disassembly Facility (PDF) will house the Projectile Pull and Drain Machine and its hydraulic package and the Central Decon System. An extension of the Projectile Disassembly Facility roof will provide shelter for the Bulk Item Facility.

The concrete floor in the PDF will be rated at 300 psi and will have curbs extending above the work areas to provide total containment of liquids. The floor will slope towards two drain sumps, one in the toxic shroud, the other in the Central Decon System area. Sump contents shall be pumped to the Agent Destruction System for certification and drying.

The housing shall be constructed of bolted panels and supporting structures which can be dismantled, shipped by rail flat cars and reassembled at another site. The housing shall provide a minimum of two personnel doors and two manually operated roll type doors.

S. Bulk Item Facility. The Bulk Item Facility (BIF) will be used to drain large munitions and ton containers. Only GB and VX-filled items will be processed through this facility. The drained agent will be transferred to the Agent Destruction System. The metal carriers will be flushed with decon solution and processed through the Metal Parts Furnace for thermal detoxification.

The Bulk Item Facility housing will incorporate a toxic drain and agent transfer area, a personnel airlock, a control room, an enclosed holding and preparation area, and a material airlock to separate the contaminated drain and transfer area from the uncontaminated holding area. The Bulk Item Facility will include material handling equipment to offload the bulk items into the holding area, transport the items into and out of the drain bays and deliver the items on the Metal Parts Furnace trays. The Bulk Item Facility will also include a ventilation system with activated charcoal filters to provide a nominal 25 air changes per hour in the toxic drain and agent transfer area, the personnel airlock, and the material airlock. A life support air system will be provided for personnel working in level A protective clothing.

The housing of the Bulk Item Facility will be constructed of bolted panels and support structures which can be disassembled and relocated to another site. Internal walls of contaminated areas will be sealed and constructed of a material which can be easily decontaminated.

The Bulk Item Facility design shall incorporate provisions to decontaminate agent drained bulk items. After draining, the empty item will be flushed internally with sufficient decon solution to assure decontamination of residual agent. Prior to removal of the bulk item from the drain bay, all potentially contaminated external areas will be rinsed with decon solution.

Opening of the bulk items for the agent drain operation and subsequent decontamination and liquid transfer operations will be accomplished by remote control. Operation of the material handling equipment to facilitate handling of the bulk items throughout the Bulk Item Facility process, will be accomplished by manual manipulation of the equipment controls. This material handling equipment will be used also to off-load mustard ton containers from the transport truck and transfer them to the Metal Parts Furnace trays.

T. Material Handling Equipment. Conveyors will be used to transfer munitions and munition components into and between toxic process locations. Because the potential of demil machine breakdown exists, where feasible, conveyors will have a capability to accumulate items at the processing rates given in Section II.A.3. These conveyors will be computer controlled from the Control Center. An alternate remote operated control system will be available with each conveyor.

The conveyors will be potentially contaminated and will, therefore, be located in totally enclosed shrouds ventilated at 25 air changes per hour through charcoal filter systems. The base of the shrouds will consist of curbed, concrete pads sloped to internal sumps to facilitate decontamination.

U. Filters. The filter ventilation system will remove air from contaminated processing areas at a nominal rate of 25 air changes per hour and will remove the agent vapors from the air prior to release to the atmosphere. The system will maintain a minimum negative pressure of .15 inches water column in toxic areas. In addition, the system will exhaust air at a nominal rate of six changes per hour from areas where there is a potential for occasional low levels of contamination. The overall air filter system shall provide a 1×10^{7} reduction in concentration of gaseous contaminants.

Each filter system shall have the same basic design varying only in capacity. In each system, the air shall be drawn at a specific volume flow from the ventilation (duct work) system and shall pass through a pre-filter, a high efficiency particulate filter, two activated carbon filters and a second particulate filter. All of the filters shall be located within air-tight housings. Each system shall be complete with blower and motor and exhaust stack.

The ventilation system shall be designed to minimize stagnant air spots in the structures. Where practicable, exhaust openings shall be placed near sources of contamination to provide spot ventilation. When ventilating areas contaminated with explosives or propellants the exhaust system shall be sized to preclude the entrainment of these materials in the air stream. Where possible, the ventilation and filter design will provide back-up systems for toxic processing areas.

All filters will be continuously monitored by agent detectors to indicate breakthrough of agent in time to replace the spent filter element prior to release of agent to the atmosphere. Signals indicating the operation of the filter systems will be displayed in the Control Center.

V. Piping. The piping system will convey air, water, chemical agents (GB and VX), decon solutions (sodium hydroxide, calcium hypochlorite and sodium carbonate), steam, hydraulic oils, scrubber brine and fuel.

Lines may be above ground and supported on racks. All liquid lines will be heated to prevent freezing.

Agent piping will be double walled to contain agent in the event of a leaking pipe or connection. The interior of the outer pipe will be monitored continuously by detectors to sense release of agent. Agent piping will be examined for flaws using freon and radiography in accordance with ANSI B31.3.

W. Electrical Distribution System. The electrical system will provide 208-volt and 480-volt power to the site and distribute the power to operating areas within the site. It will also furnish emergency power in the event of a commercial power failure.

The emergency generator system will activate automatically 10 seconds after commercial power failure and will be capable of supplying power to critical operations where loss of power could cause a safety hazard.

X. Perimeter Monitoring. The Perimeter Monitoring network will sample the ambient air quality at points about the CAMDS site to determine the background concentration of various pollutants in the atmosphere entering and leaving the CAMDS site. The Perimeter Monitoring network will incorporate eight stations along a perimeter about 2 miles from the CAMDS site. Each station will monitor ambient air concentrations of sulfur dioxide, nitrogen dioxide, total oxidants expressed as ozone, particulate matter and anticholinesterase material at the concentrations cited in Section II.A.6. Wind speed and wind direction will also be measured.

The stations must operate continuously and without servicing for periods up to 24 hours. Regular maintenance should include only refurbishing reagent supplies and recorder chart papers and returning collected samples to the laboratory for analysis. Maximum instrument sensitivity and minimum drift are required.

Each station must provide the instrumentation shelter from precipitation and protection from extreme temperatures. Each station must be maintained in a 60-80°F range to afford optimum instrument performance.

Y. Closed Circuit Television. Closed circuit television will be used to observe operations of machines, conveyors and maintenance operations in contaminated areas from the Control Center. As a minimum, coverage will be required for remote controlled operations in the ECC and the Projectile Pull and Drain systems, the punching chamber of the Metal Parts Furnace and the toxic enclosure of the Agent Destruction System.

The cameras may be subjected to severe abuse and differing environmental conditions and, therefore, must be designed for industrial application where long-term dependability, shock resistance, and rugged construction are manufactured into the system. All components are to be of the latest in transistorized circuitry which will contain its own temperature compensation within the system so that no external devices are necessary for stable operation. The equipment will be designed to minimize maintenance within toxic areas.

Z. Chemical Laboratory. The Chemical Laboratory will provide chemical analytical support required by CAMDS to include process samples, agent detector samples, product certification and Perimeter Monitoring samples. The laboratory will have an analytical capability for all agents processed by CAMDS to include H, HD, HT, GB and VX.

To provide results in a timely fashion, analytical procedures will be automated to the greatest degree practical. Routine analyses are to include determination of agent concentrations in various samples, active chlorine analysis of decon solutions, and analysis of ambient air samples for pollutant concentration.

Determination of agent concentrations requires the use of standard agent sources. All toxic materials must be controlled and contained within laboratory fume hoods. Wastes generated by toxic analyses will be segregated and packaged for disposal by CAMDS. In addition to normal electrical service, stand-by emergency power generators are required to supply power to hoods during any interruption of normal electrical service.

AA. Communications. CAMDS will have an internal communication system within the site. Each control station shall be able to originate calls to, and receive calls from, any other control station in the system. The system shall have a general site page and a conference call ability on all stations. A priority interrupt feature will be provided to allow any station to break into any two-way conversation. Each station shall have a switch that allows connection to a common line. The common line must allow all stations in the system to connect to it simultaneously. The system will allow a minimum of six simultaneous two-way conversations in addition to a common talk line. A central exchange will have a capability for 50 extensions.

BB. Detectors. Chemical agent detectors will monitor the CAMDS site for the presence of toxic agents to protect plant operators and the surrounding populace and to monitor the plant processes. The detectors will have the capability to detect any agent processed by CAMDS to include H, HD, HT, GB and VX.

The detectors shall monitor stack gases and plant operating areas for the presence of agent. The detectors shall use automatic instrumentation to continuously monitor for the presence of agent and give warning of any detected concentrations. The established sensitivity requirements for the detectors for each agent are cited in Section II.A.6. The automatic detectors shall have strip chart recorders to give a permanent record of agent concentrations detected. Bubbler absorption systems shall be provided to air collect samples for determination of low level average agent concentrations in working areas.

The response time of the detectors shall be as near instantaneous as possible to give immediate warning of dangerous concentrations of agent. Instrument limitations may force the use of two systems; one system with rapid response but sensitivity not as great as listed, and one system with relatively slow response but meeting the listed sensitivity requirements.

The detectors will require minimal maintenance and provide maximum unattended operation. Regular maintenance shall include changing chart paper, replenishing reagent supplies, checking sample flow, and checking instrument zero. No further regular maintenance should be required to sustain continuous detector operation.